TECHNICAL NOTES

U.S. DEPARTEMENT OF AGRICULTURE
AGRONOMY – 5

NATURAL RESOURCES CONSERVATION SERVICE
SPOKANE, WASHINGTON
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ESTIMATING FURROW EROSION

This technical note provides a procedure for estimating furrow erosion rates for use in evaluating sediment transport for East Washington in Water Quality Technical Note 2, The Phosphorus Index. This procedure will be used only to determine sediment transport for planning purposes. Improvement and values for implementing irrigation practices shall use currently approved irrigation planning tools.

The original nomograph was developed by William F. Weller in 1978 for estimating annual sediment volumes. It was based on the best local and regional erosion and sediment data available at the time. **It was again revised in 1985 as Agronomy Note 23 for use as a planning tool on irrigated land for evaluating erosion rates before and after various irrigation treatments.

The modified nomograph uses a dry soil density of 85 pounds per cubic foot to convert the final result to tons/acre. This was the original value used to convert erosion data to cubic yards, along with a delivery rate of 50% for "A" slopes, 62% for "B" slopes, and 71% for "C" slopes. Problem:

1. Determine the average annual erosion rate for a furrow-irrigated silt loam soil in a 100-acre field with runs of 1300 feet and furrow slopes of 5%. The rotation is potato-wheat-corn in a conventional farming system without irrigation water management.
2. Determine the average annual "after" effect of various alternatives.

Procedure:

Step 1. Enter the nomograph at the proper soil texture in Section 1. Move vertically to the "erodibility line". (SIL) If "K" factor is known, go directly into Section 2.

Step 2. Turn at the erodibility line and move to the right in Section 2 until the irrigation run to be evaluated is intersected. It may be necessary to interpolate. (1300').

Step 3. Move vertically down from the length of run line to the line in Section 3 corresponding with the furrow slope in %. It may be necessary to interpolate. (5%).

Step 4. Next, move horizontally to the left to Section 4 and find the crop to be evaluated. (Potatoes)

Step 5. Finally, move vertically upward to the applicable erosion scale, in this case "B", and read the erosion rate for the evaluated crop in tons/acre).

A slopes: 1-2%
B slopes: 3-5%
C slopes: 6+%

Step 6. Do the same for wheat. (9 tons/acre)

Step 7. Do the same for corn. (17 tons/acre)

Step 8. Average the erosion rates for each crop in the rotation to determine the rotational average erosion rate which is synonymous with average annual erosion rate in tons/acre/year (16 tons/acre/year: solution to problem No.1, above).

Step 9. The acres in the field multiplied by the average annual erosion rate will provide the "before" tons/year (100 x 16 = 1600 tons/year).

Step 10. Use erosion rate reduction factors in Table No. 1 to determine "after" arosion rates, for different conservation treatment.

Example A: What is the effect of water cutback?

Rotation	Before	Water Cutback .7
Potato	21	14.7
Wheat	9	6.3
Corn	17	11.9
AVERAGE	16 T/Ac/Yr	11 T/Ac/Yr

Example B: What is the effect of conservation tillage?

Rotation	Before	Conservation Tillage .5
Potato	21	10.5
Wheat	9	4.5
Corn	17	8.5
AVERAGE	16 T/Ac/Yr	8 T/Ac/Yr

Example C: What is the effect of Crop Residue Use?

Rotation	Before	Crop Residue Use .4
Potato	21	8.4
Wheat	9	3.6
Corn	17	6.8
AVERAGE	16 T/Ac/Yr	6 T/Ac/Yr

Example D: What is the effect of a system using all three practices?

.7 x .5 x .4 = .14

Rotation	Before	All Three .14
Potato	21	2.9
Wheat	9	1.3
Corn	17	2.4
AVERAGE	16 T/Ac/Yr	2 T/Ac/Yr

Example E: What is the effect of irrigation water management?

One or more of the following steps may be involved in this alternative:

a. The length of run my be reduced and evaluated with the nomograph.

b. Water cutback may be a part of the IWM (See Table 1).

c. The irrigation efficiency may be increases (see Weller nomograph No. 2 for effect on sediment).

d. Examples "A" through "D", above, may be combined with "E" for a total RMS:

Example: The length of run was reduced to 700 feet. With water cutback, what is the average annual erosion rate for the silt loam soil with furrow gradient of 5 % in a potato-wheat-corn rotation with conservation tillage and crop reside use?

Rotation	Before	700 Ft. Run	Water Cutback .7	Conservative Tillage & Crop Residue Use .5 w .4 or .2
Potato	21	14	9.8	1.96
Wheat	9	7	4.9	0.98
Corn	17	11	7.7	1.54
AVERAGE	16 T/Ac/Yr	11	7 T/Ac/Yr	1 T/Ac/Yr

Conclusion: Consider all forms of erosion to make a complete analysis of the effects of the management system on soil erosion.

Winter runoff in irrigated land can be evaluated with the USLE and the irrigated "C" factor table in Section II-D of the Technical Guide. This table provides a winter "C" factor for residue and/or one for green cover that can be used as the "C" factor in the equation. Both can be used if both are on the surface over winter.

Wind erosion rates are to be evaluated using current wind evaluation procedures.

Concentrated flow erosion can be estimated from the average annual voided area of soil removed.

Combined wind and rill erosion rates only are to be compared to T.

Table No. 1: Furrow Erosion Rate Reduction by Conservation Practices.

Conservation Practice	% Reduction	Factor
Water Cutback	30	.70
Orchard or Vineyard Cover Crops	75	.25
Conservation Tillage/Minimum Tillage	50	.50
Crop Residue Use	60	.40
Water Management [1/]	--	--

Table No. 2: Concentrated Flow Erosion Rate Reduction [2/]

Conservation Practice	% Reduction	Factor
Grassed Waterway	50	.50
Total Control with Pipes or Other Structures	100	.00

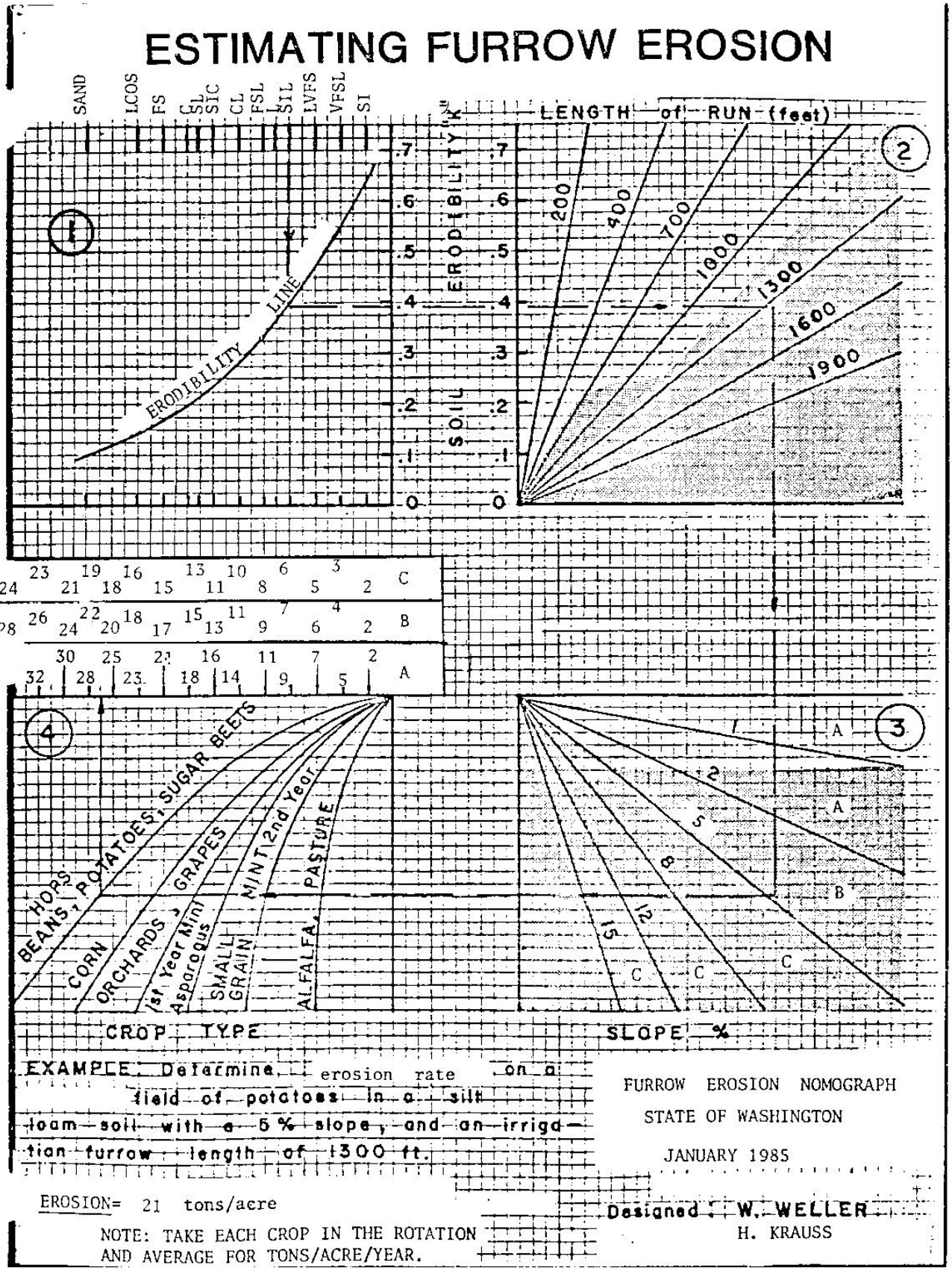
Table No. 3: Sediment Reduction Factors

Conservation Practice	% Reduction	Factor
Tailwater System with Vegetative Strip	50	.50
Sediment Basin	(Use original Weller nomographs No. 1 and 2)	

[1/] Reduce length of run, if appropriate, and enter section 2 of nomograph using shorter run length.

[2/] Use only to reduce estimated or measured concentrated flow erosion not rotational average rill erosion.

ESTIMATING FURROW EROSION



EXAMPLE: Determine erosion rate on a field of potatoes in a silt loam soil with a 5% slope, and an irrigation furrow length of 1300 ft.

EROSION= 21 tons/acre

NOTE: TAKE EACH CROP IN THE ROTATION AND AVERAGE FOR TONS/ACRE/YEAR.

FURROW EROSION NOMOGRAPH
STATE OF WASHINGTON
JANUARY 1985

Designed: W. WELLER
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